Odds and Probabilities

Both odds and probabilities are quantifications of the **likelihood** of an event. Although in everyday life we use the terms odds, probability, chance and likelihood interchangeably, these terms have specific meanings in statistics.

- **The probability** is the relative frequency of occurrence of a given event over a sequence of unlimited random trials done under similar conditions. In simple terms, probability compares the number of events of interest to the total number of trials during which the event may occur. It can take any value between 0 and 1 only. Probability can also be expressed in percentages (ranging between 0% to 100%).
  - Suppose 'p' is the probability of an event occurring. Then
  - If p = 0, then the event cannot occur
  - If p = 1, then the event must occur
  - The probability of an event not occurring is given by p = (1-p). This is called the probability of a complementary event.
- **Odds** are a ratio of the frequency that an event occurs to the frequency that the event does *not* occur (or a different event occurs in its place). In simple terms, odds compare the number of events of interest to the number of other events in the trial. So while calculating odds, we must keep the numerator and the denominator mutually exclusive.

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Assume that a sequence of events makes up a total number N (e.g. number of coin tosses made). The events are of two types – event A (e.g. 'heads' in a coin toss) occurs n(A) times and event B (e.g. 'tails' in a coin toss) occurs n(B) times. Then,

P (heads) = n (heads)/No. of tosses

P (tails) = n (tails)/No. of tosses

Odds of heads = n (heads)/n (tails)

Odds of tails = n (tails)/n (heads)

Probability may be easily converted into odds using the following equation:

$$Odds = \frac{Probability}{1 - probability}$$

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Odds may be easily converted into probability using the following equation:

$$Probability = \frac{Odds}{1+Odds}$$

Probability of multiple events:

If two events X and Y are related but mutually exclusive (X can't happen if Y has happened) then probability of either X or Y happening is given by p(X or Y) = p(X) + p(Y). This is called the addition rule for mutually exclusive events. Examples of mutually exclusive events include toss of a coin - heads and tails, or blood groups A, B, O and AB. Probability of getting a head or a tail for a toss is P(Heads or Tails) = P(heads) + P(Tails)

If two events X and Y are unrelated then probability of both X and Y happening is given by p(X and Y) = p(X) * p(Y). This is called the multiplication rule for independent events. Consider the probability of finding a male with blood group A. Being a male does not affect the blood group – hence these two are independent events. The probability is given by P(Male with A group) = P(Male) X P(Blood group A)

(There are more addition and multiplication rules, but the above must suffice for the Membership exams.)

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P (A) = n (A)/N
P (B) = n (B)/N

Odds of A = n (A)/n (B)
Odds of B = n (B)/n (A)

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